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U. S. Department of Agriculture
THE MEXICAN MEALYBUG ON GREENHOUSE CHRYSANTHEMUMS

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The Mexican mealybug, known scientifically as Phenacoccus gossypii Towns. and Ckll., has become in recent years a serious pest of chrysanthemums in greenhouses, where it attacks the leaves, stems, and flowers and is responsible for losses of 40 to 50 percent or more of the crop. Practically all varieties of chrysanthemums are attacked, and if no control measures are practiced the plants will be killed outright. This mealybug will feed on and injure many other greenhouse crops, including gerbera, coleus, fuchsia, Christmas pepper, Bouvardia, and calendula. It was first found in this country in California in 1917 and since then has spread over most of the Southern, North-central, and Eastern States as far north as Michigan and New York.

General Appearance and Habits

The Mexican mealybug is similar in general appearance to other greenhouse mealybugs. The adult female is light bluish gray in color and about one-eighth inch long. It has a ridge down its back, on either side of which is a row of dots. The eggs are laid in a cottony sac. The male mealybug passes part of its life in a cocoon and emerges later as a tiny 2-winged flylike insect. An unusually high number (400) of eggs are laid, and this fact probably accounts in part for the rapid increase and severity of attack. At normal greenhouse temperatures a new generation develops in 6 or 7 weeks, but under hot summer conditions the period of development is even shorter. The mealybug attacks the chrysanthemum throughout the year, passing the winter on the stock plants in coldframes or cool greenhouses. Although many eggs are killed by temperatures below 40° F., the mealybug will withstand freezing temperatures and has been found to overwinter successfully in coldframes where the temperature has fallen as low as 22° F. for short periods. It did not overwinter out of doors around Washington, D. C., during the winter of 1934-35, in which the minimum temperature was -2° F.

Mealybug Spreads on Stock Plants or Rooted Cuttings

The main method of spread of this mealybug is by the exchange or sale of infested chrysanthemum stock plants or rooted cuttings. For this reason the examination and treatment of all incoming stock is a very important measure in preventing the entrance of the insect. If possible, segregate infested plants in a small separate unit and fumigate them with calcium cyanide or apply an effective spray.

Calcium Cyanide Fumigation Gives Effective Control

The Mexican mealybug has been found to be much more easily affected by cyanide than two other common greenhouse mealybugs. Overnight fumigations with 3/16 of an ounce of calcium cyanide (granular form, 40-50 percent $\text{Ca}(\text{CN})_2$) per 1,000 cubic feet of space will kill from 90 to 95 percent of the mealybugs and from 6 to 12 percent of the eggs in a tightly built greenhouse, provided the correct conditions for fumigation are followed. A dosage slightly higher than ordinarily used for aphid control should be effective, but if the house is quite leaky, increase this by 1/8-ounce amounts until the effective dosage is reached. Do not try to use higher dosages than necessary. The effectiveness of the treatment cannot be definitely determined until the fourth or fifth day after fumigation, as mealybugs recover if too low dosages are used. Four to six fumigations at weekly intervals are recommended for control. Some growers fumigate regularly at 8 to 10 day intervals during most of the growing season and have been very successful in controlling the mealybug. When time is limited, as in the treatment of a crop just before blooming, fumigations may be made at 1 to 2 day intervals and repeated from 3 to 5 times. No injury to chrysanthemum flowers in any stage of bloom has been noted, though injury may occur if thrips or red spider mites have damaged the petals. The more important precautions for calcium cyanide fumigation are as follows:

Do not start fumigations until one-half hour to 1 hour after sunset. The plants should not be watered within from 12 to 24 hours preceding fumigation and the foliage should be dry. The walks may be damp but not wet. Temperatures should be between 55° and 70° F., and it is important that heat be set so that the temperature will gradually rise from 5° to 8° during the night. Open the greenhouse early the next morning. Do not fumigate on windy or rainy nights. Calcium cyanide should be handled with extreme care, as its fumes are very poisonous.

Late in the spring and in summer when the heating plant is not in operation fumigations should not be started until 2 to 3 hours after sunset, or until 10 to 11 p.m., by which time the temperatures will have fallen. Do not close the ventilators until just before fumigation. If the temperature is still 72° F. or above at this time, use two-thirds to three-quarters the quantity of calcium cyanide normally used or postpone the fumigation until the next suitable night.

Some growers believe that cyanide fumigation will stunt the plant, but no indication of this has been noted in the many fumigations made. If, however, the plants are kept too much "on the dry side", it is possible that a stunting, wilting, or hardening effect may result. Water the soil to such an extent that there will be no danger of this, at an interval sufficiently long before fumigation so that the foliage will be dry and there will be no free water on the soil at the start.

Although chrysanthemums in all stages of growth have been fumigated safely, they are plants of a class that may be injured unless the conditions for fumigation are correct. A large number of varieties, in bloom as well as at other stages of growth, have been fumigated safely; these include the large-flowered commercial types Citronella, Seidewitz, Friendly Rival, Gold Lode, Harvard, Honeydew, M. de Petris, October Rose, R. M. Calkins, Silver Sheen, Sunglow, Golden Glory, Indianola, Rose Perfection, Sun Gold, and Will Rogers, as well as a large number of pompon, anemone, single, and exhibition types. The large-flowered commercial varieties Dr. Enguehard, G. Pearson, and Betsy Ross (especially the first) and the pompon Chicago Pearl are slightly sensitive but can be fumigated safely where the correct conditions are maintained.

The Pot Method of Generating Hydrocyanic Acid Gas may be Used

Where the grower is familiar with and has the equipment for generating hydrocyanic acid gas with sodium cyanide and sulphuric acid, this method can be successfully used. A 1/2-ounce dosage of sodium cyanide with a one-half hour exposure will give good control of the older stages, but many eggs will survive and fumigations must be repeated as recommended for calcium cyanide. There is not much difference in the costs of materials with either method, but the pot method has several disadvantages. Most important of these is the fact that the greenhouse must be opened up from one-half to 1 hour after the start of fumigation when the hydrocyanic acid gas concentration is high. This necessitates the use of a gas mask or the installation of special equipment for opening the greenhouse ventilators from the outside. Even where a gas mask is used, it is advisable that more than one person be present when the greenhouse is being opened. In cold weather, after the greenhouse has been ventilated, it is necessary to close the ventilators once again. In addition, the use of pots and sulphuric acid necessitates extra time and preparation in measuring and weighing the chemicals, and the acid is likely to spatter and injure clothing and shoes.

Short exposures of 3 to 4 hours with calcium cyanide can be used at higher dosages than those given herein, but it will increase the care and costs. The tolerance of the chrysanthemums is probably somewhat greater to these short exposures, using the pot method or calcium cyanide, but overnight exposures with calcium cyanide can be used safely on chrysanthemums, are effective against the mealybug, and are much easier and safer to use from the operator's standpoint.

Effective Sprays

Where cyanide fumigation cannot be used, as in greenhouses containing other crops, such as snapdragon, sweetpea, or asparagus fern, which are sensitive to the gas, or where infested chrysanthemums are being grown out of doors, an effective spray is needed. A 10 percent kerosene emulsion has been found to kill from 90 to 95 percent of the older mealybugs and from 25 to 40 percent of the eggs. Applications should be made on cloudy days or late in

the afternoon of bright days, and the plants should be syringed with water the next morning. Apply the spray 4 or 5 times at weekly intervals. A large variety of chrysanthemum plants in various stages have been treated safely in greenhouses with this spray. The flowers are likely to be injured. Infested chrysanthemums out of doors have also been sprayed effectively. The newer synthetic thiocyanate sprays have also shown considerable promise, killing especially large numbers of eggs. One spray containing lauryl thiocyanate (0.085 percent) has consistently given kills of 85 to 90 percent of the young and old mealybugs and near 80 percent of the eggs. Three or four thorough applications at 7 to 10 day intervals should bring the mealybug under control. This spray was as cheap as kerosene emulsion, easier to prepare, and no water syringing has appeared necessary. Use it rather than kerosene emulsion on plants in coldframes. Plant tolerance has so far been good, though with some thiocyanate sprays care must be taken in preparing the spray, and a water syringing shortly after application is recommended in order to avoid spray injury. Thoroughness of application is the most important factor to be observed with an effective spray. Use a pressure of 150 to 200 pounds.

There are several other factors which must be considered in the use of sprays. The first is the quality of the spray. It should be as fine as possible, and should be applied in a uniform manner. The second is the time of day. Spraying should be done in the early morning or late afternoon, when the temperature is low and the wind is light. The third is the weather. Spraying should be done on a clear day, when the sun is shining and the wind is light. The fourth is the type of plant. Some plants are more tolerant of sprays than others. The fifth is the type of pest. Some pests are more easily killed than others. The sixth is the type of spray. Some sprays are more effective than others. The seventh is the type of application. Some applications are more effective than others. The eighth is the type of equipment. Some equipment is more effective than others. The ninth is the type of operator. Some operators are more effective than others. The tenth is the type of results. Some results are more effective than others.

Short exposure of 2 to 4 hours with certain sprays has been found to be effective in killing mealybugs. It will, however, increase the cost and reduce the tolerance of the chrysanthemum. It is probably somewhat greater in those cases where the pest is not so numerous or where the plants are more tolerant. In general, the most effective method of control is the use of a good spray, applied in a uniform manner, at the right time, in the right weather, on the right type of plant, with the right type of spray, by the right type of operator, using the right type of equipment, and obtaining the right type of results.

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